

ASSIGNMENT, LOOPS, AND BASIC TYPES

Outline

- Variables and assignments
- Definite loops
- Basic types: numbers (int and float)
- Math library
- Accumulator problem

Variables and Assignments

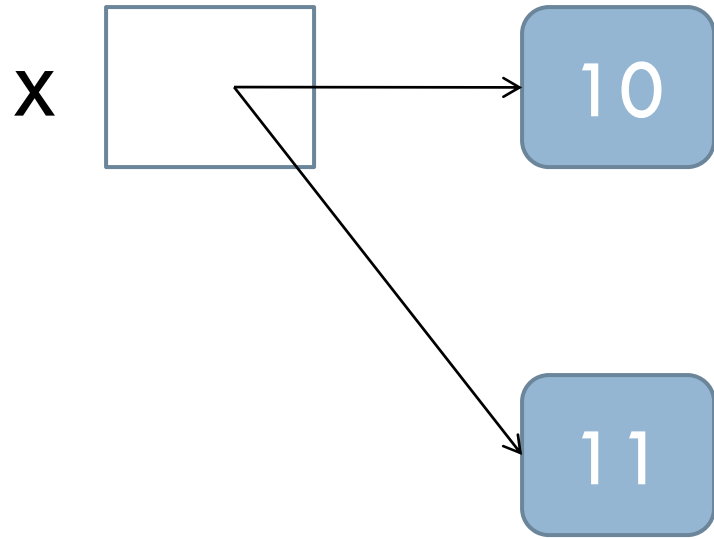
□ Variable

- Identifier that stores a value
- A value must be *assigned* to the variable
- $\langle \text{variable} \rangle = \langle \text{expr} \rangle$ (syntax)

□ Assignment

- Process of giving a value to a variable
- Uses = (equal sign)
 - $x = 0.25$
 - $x = 3.9 * x * (1 - x)$

Variables as sticky notes



x = 10

x = x + 1

Assignment Statements

- Simple assignments
 - ▣ `<variable> = <expr>`
- Input assignments
 - ▣ `<variable> = input(<prompt>)`
 - `temp = input("Enter high temperature for today")`
- Simultaneous assignments
 - ▣ `<var>, <var>, ..., <var> = <expr>, <expr>, ..., <expr>`
 - `sum, diff = x + y, x - y`

Sequences

- A list of things
- For example:
 - [2, 3, 5, 7]
 - ["My", "dog", "has", "fleas"]
- Can be generated by the range function
 - range(<expr>)
 - range(<expr>, <expr>)
 - range(<expr>, <expr>, <expr>)

Definite loops

- Definition

- **Loop:** a **control structure** for executing a portion of a program multiple times
- **Definite:** Python **knows** how many times to **iterate** the body of the loop

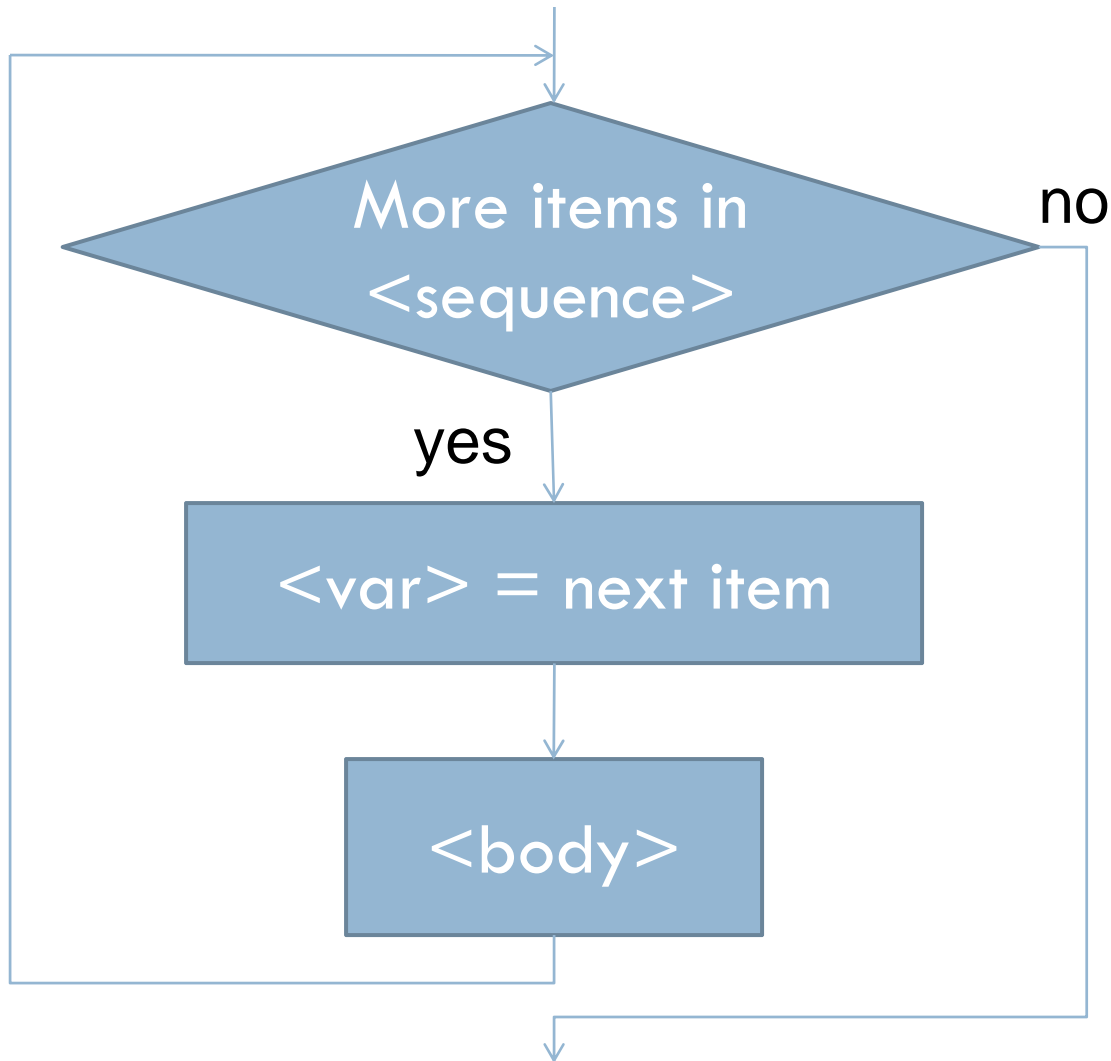
- Syntax:

```
for <var> in <sequence>:  
    <body>
```

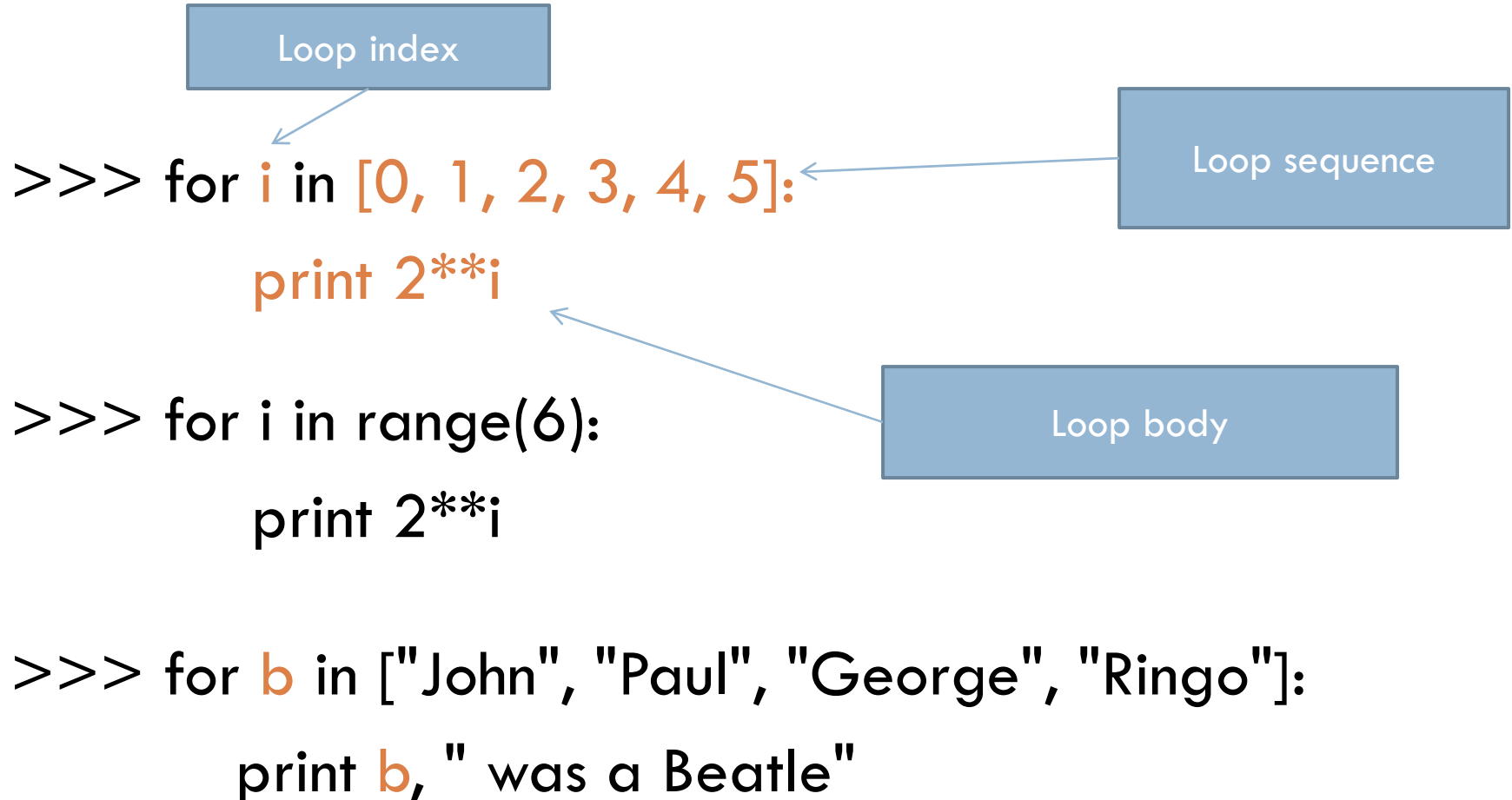
Counted Loops

- A *counted loop* is a definite loop whose sequence can be generated with `range(...)`
- Example:
 - ▣ `for x in range(2,4):`
 `print x`
- Example of a loop that isn't a counted loop:
 - ▣ `for p in [2, 3, 5, 7, 11]:`
 `print p, "is prime"`

Flowchart for a for loop



Examples using loops



Data types

□ *Data*

- Information stored and manipulated on a computer
- Different kinds of data will be stored and manipulated in different ways

□ *Data type*

- A particular way of interpreting bits
- Determines the possible values an item can have
- Determines the operations supported on items

Numeric data types

- From Angel copy the content of the following file and place it in a new Python window:

Lessons → Modules to Download in Class →
Session 3 → change.py

- Save as myChange.py

- Numeric types
 - Whole numbers int
 - Fractional numbers float

Finding the Type of Data

- Built-in function `type(<expr>)` returns the data type of any value
- Find the types of: 3, 3.0, -32, 64.0, “Shrubbery”, [2, 3]
- Why do we need different numerical types?
 - ▣ Operations on int are more efficient
 - Compute algorithm for operations on int are simple and fast
 - ▣ Counting requires int
 - ▣ Floats provide approximate values when we need real numbers

Some Numeric Operations

Operator	Operation
+	addition
-	subtraction
*	multiplication
/	division
**	exponentiation
%	remainder
//	Do integer division (even on floats)

Function	Operation
abs(x)	Absolute value of x
round(x, y)	Round x to y decimal places
int(x)	Convert x to an int data type
float(n)	Convert n to a float data type

Math library functions

From Angel copy the content of the following file and place it in a new Python window:

Lessons → Modules to Download in Class →
Session 3 → quadratic.py

Save as `myQuadratic.py`

□ Finds real roots for quadratic equations of the form

$$ax^2 + bx + c = 0$$

□ Solution

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

More math library components

Python	Mathematics	English
pi	π	Approximation of pi
e	e	Approximation of e
sin(x)	sin x	The sine of x
cos(x)	cos x	The cosine of x
tan(x)	tan x	The tangent of x
log(x)	ln x	The natural (base e) log of x
log10(x)	$\log_{10}x$	The base 10 log of x
exp(x)	e^x	The exponential of x

Built-in Help

- `dir()`
- `dir(<identifier>)`
- `help(<identifier>)`

EXPLORING WITH PYTHON



Pair Programming

- Working in pairs on a single computer
 - ▣ One person, the *driver*, uses the keyboard
 - ▣ The other person, the *navigator*, watches, thinks, and takes notes
- For hard (or new) problems the technique:
 - ▣ Reduces number of errors
 - ▣ Saves time in the long run

Problem 1

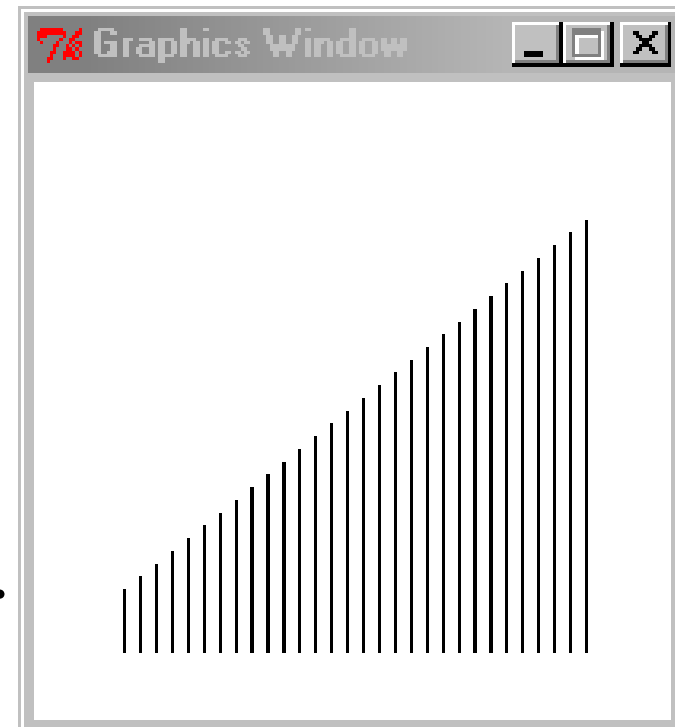
- Suppose you are at food tasting show and are tasting 5 different dishes.
- Sampling the dishes in different orders may affect how good they taste.
- If you want to try out every possible ordering, how many different orders would there be?
 - ▣ That number is the factorial of 5
 - ▣ $n! = n (n - 1) (n - 2) \dots (1)$
- What type of problem is this?

Accumulating results: factorial

- Work in groups of two
 - ▣ Pick one person to drive and the other to navigate
 - ▣ If you have programmed before, try to find a partner who has also done so
- In groups of 2 write a Python program that
 - ▣ Prompts the user for an integer
 - ▣ Calculates the factorial of the integer
 - $n! = n (n - 1) (n - 2) \dots (1)$
 - ▣ Outputs the result to the screen

Graphics Exercise with loops

- Trade roles with partner—new driver, new navigator
- Write a program that draws a figure like this where the lengths of the lines increase by a constant amount.
- Use your previous graphics program as a model of how to import graphics functions, create a window, etc.
- You may want to use variables to hold current x-coordinate and current line length, and change the values of those variables each time through the loop.



Submitting your programs

- Meet before next class to finish them
- Driver: email the code to your partner (so each has the program for the open-computer parts of exams)
- Log into Angel and go to the class's webpage
- Click on the lessons tab then go to Homework > Homework 3
- Submit the factorial program in the **Factorial Drop Box**
- Submit the line drawing program in the **Bar Chart Drop Box**